

May 5, 1998

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**NOAA SHIP MILLER FREEMAN
Cruise No. 98-02
Preliminary Cruise Results
Echo Integration-Trawl Survey of the Southeastern
Aleutian Basin near Bogoslof Island**

**Midwater Assessment and Conservation Engineering
Alaska Fisheries Science Center
Seattle, WA 98115**

Scientists from the Alaska Fisheries Science Center (AFSC) investigated the population distribution and characteristics of spawning walleye pollock (*Theragra chalcogramma*) in the southeastern Aleutian Basin near Bogoslof Island March 1-10, 1998, (10 sea days) using echo integration-trawl (EIT) survey techniques aboard the NOAA ship *Miller Freeman*. This research cruise was the tenth in a series that began in 1988 and has been continued annually with the exception of 1990 as part of long-term monitoring of Bering Sea walleye pollock. In 1998, the cruise began and ended in Dutch Harbor, Alaska, and was a cooperative effort involving scientists from the United States, Japan, and South Korea.

The vessel's itinerary was as follows:

Feb 27	Embark scientists in Dutch Harbor, AK.
Mar 1	Standard sphere calibration in Nateekin Bay, AK.
Mar 2-9	Echo integration-trawl survey of the Bogoslof Island region.
Mar 10	Standard sphere calibration in Captains Bay, Dutch Harbor, AK; end of cruise.

The primary cruise objectives were to collect echo integration data and midwater trawl data essential to determine the distribution, biomass, and biological composition of walleye

pollock in the southeastern Aleutian Basin. The 38 kHz and 120 kHz scientific acoustic systems were calibrated using standard sphere techniques. Sea surface temperature and salinity were monitored continuously, and water column profiles were collected at selected sites. An acoustic Doppler current profiler was operated continuously in the water profiling mode.

Secondary objectives involved a number of separate projects and investigators from the AFSC, the University of Alaska, and the Alaska Department of Fish and Game (ADF&G).

METHODS

Sampling Equipment

Acoustic data were collected with a Simrad EK500¹ quantitative echo-sounding system on board the NOAA ship *Miller Freeman*, a 66-m (216 ft) stern trawler equipped for fisheries and oceanographic research. The Simrad 38 kHz and 120 kHz split-beam transducers were mounted on the bottom of the vessel's centerboard. With the centerboard fully extended, the transducers were 9 m below the water surface. System electronics were housed inside the vessel in a permanent laboratory space dedicated to acoustics. Data from the Simrad EK500 echo sounder/receiver were processed using Simrad BI500 echo integration and target strength data analysis software on a SUN workstation. Results presented in this document are based on the 38 kHz data.

Midwater echo sign was sampled using an Aleutian Wing 30/26 trawl (AWT), a full mesh wing trawl constructed of nylon except for polyethylene towards the aft section of the body and the codend. Headrope and footrope lengths each measured 81.7 m (268 ft) and mesh sizes tapered from 325.1 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codend. The net was fitted with a 3.2 cm (1.25 in) codend liner. It was fished with 82.4 m (270 ft) of 1.9 cm (0.75 in) diameter 8x19 non-rotational dandyline, 227.3 kg (500-lb) tom weights on each side, and 5 m² "Fishbuster" doors [1,250 kg (2,750 lb)]. Vertical and horizontal net opening and depth were monitored with a WesMar third wire netsounder system attached to the headrope of the trawl.

Temperature/depth data were collected with a micro

¹ Reference to trade names or commercial firms does not constitute U.S. Government endorsement.

bathythermograph (MBT) attached to the headrope of all trawls. Conductivity-temperature-depth (CTD) data were collected with a Seabird CTD system at calibration sites and selected locations. While transecting, we collected temperature-depth profile data at one location using an expendable bathythermograph (XBT). Sea surface temperature and salinity, environmental data, and data for the Marine Operations Abstract (MOA) were collected using the *Miller Freeman's* Scientific Collection System (SCS). Ocean current profile data were obtained using the vessel's acoustic Doppler current profiler system whose transducer is mounted in the centerboard.

Survey Methods

Four standard sphere calibrations of the acoustic systems were made in conjunction with the survey (Table 1). No significant differences were observed in the 38 kHz system parameters among the four calibrations. Results from calibration of the 120 kHz system are not presented here as that system was not used in the acoustic data analysis.

We surveyed the Bogoslof Island spawning area between March 2 and 9 covering about 1500 nautical miles (nmi) of transects (Fig. 1). The trackline consisted of 27 north-south parallel transects beginning at about long. 166°W and ending near long. 170° 20'W. Transect spacing at the eastern end was 10 nmi and decreased to 5 nmi between transects 5.0 and 16.0. Southern transect endpoints were at approximately 100 m bottom depth on the Aleutian shelf but varied depending on bottom depth and fish echo sign. The northern extent of the 10 nmi-spaced transects was similar to that during previous winter surveys in the Bogoslof region (i.e., between latitudes 54°30'N and 54°40'N east of long. 168°W and between latitudes 54°N and 54°30'N west of long. 168°W).

Echo integration and trawl data were collected 24 hours a day. Vessel speeds averaged 11.5 kts during acoustic data collection and ranged between 5 and 15 kts, depending upon weather conditions. We collected echo integration data from 14 m below the surface to either within 0.5 m of the bottom or to 1000 m, depending on bottom depth. These data were thoroughly scrutinized by one or more scientists and stored in an INGRES database. When properly scaled, they were used to provide estimates of pollock density.

Midwater trawl hauls were made at selected locations to identify echo sign and provide biological data and pollock samples. Haul duration was kept to the minimum necessary to ensure an adequate

sample. Average trawling speed was about 3 kts. The AWT's vertical opening averaged about 24 m. Each trawl catch was completely sorted unless it exceeded about 1000 kg, at which point representative splits of the catch were sorted instead. Total weights and numbers of individuals, by species, were determined for each catch. Individual pollock were further sampled to determine sex, fork length, body weight, age, maturity, and ovary weight. Both otoliths were removed and stored in a solution of 50% ethanol. An electronic scale was used to determine all weights taken from individual pollock specimens. Fish lengths were determined to the nearest cm with a polycorder measuring device (a combination of a bar code reader and a hand-held computer). Since the winter of 1996, maturities have been determined by visual inspection of gonads based on an internationally accepted 8-stage scale. Expressed in terms of the older 5-stage scale, the stages were categorized as: immature, developing 1 & 2, pre-spawning 1 & 2, spawning, and post-spawning 1 & 2.

Several special projects were completed in addition to species collections associated with the estimation of pollock biomass. Mature walleye pollock were spawned and the fertilized eggs cultured for laboratory experiments on eggs and larvae. Pollock ovaries were collected from pre-spawning females for a study of interannual variation in fecundity. Fin, muscle, heart, and liver samples were taken from walleye pollock for FOCI/ADF&G genetic research. Samples of forage fishes (myctophids) were frozen for a University of Alaska (Fairbanks) study on seabird food habits. Whole pollock were collected and frozen for the Observer Program, AFSC. Grenadier were collected for AFSC biologist, Jerry Hoff.

PRELIMINARY RESULTS

Biological data were collected and samples preserved from 14 midwater trawls (Fig. 1, Tables 2-4). Pollock dominated the catches in both weights and numbers (Table 5), but large numbers of lanternfish were also caught.

Pollock distribution was similar to that in 1997. Except for one very dense school observed just northeast of Umnak Island, light to moderate concentrations of pollock were encountered between longitudes 166°-166°30'W and in the southern portion of the survey area along the Aleutian Island chain between longitudes 166°30'-168°30'W (Fig. 2). As in the previous two years' Bogoslof area surveys, most pollock (73% of the biomass) were concentrated in Samalga Pass between Umnak Island and the Islands

of Four Mountains (long. 169°-170°W). They were distributed in spawning aggregations 5-12 miles in horizontal extent and 200-300 m in vertical extent between 300-700 m in the water column.

The average sizes of pollock increased from east to west. The eastern-most hauls (hauls 1 and 2) caught pollock with lengths averaging 49 cm/46 cm for females/males, respectively (Fig. 3a). Between longitudes 167°-168° W, average lengths were 54 cm/50 cm for females/males (Fig. 3b). Lengths of pollock encountered west of long. 168°W averaged 56 cm/52 cm for females/males, respectively (Fig. 3c). Sampled lengths ranged from 34-68 cm for sexes combined. The male sex ratio by haul ranged from 0.03 to 0.91 (average = 0.49). Preliminary estimates indicated that most pollock maturities were pre-spawning 1 & 2 (coded 4 and 5 in the current 8-point scale); 74% of males and 91% of females were pre-spawning (Fig. 4). Only 3% of females were actively spawning. The mean gonadosomatic index (GSI) for prespawning females was 0.18 (Fig. 5). At just under 0.5 million tons, total pollock biomass in the Bogoslof area (Fig. 6) appeared to be slightly higher than it was in 1997.

Oceanographic data were collected from 14 successful MBT casts (Table 2), 8 CTD casts, and 1 XBT cast (Table 6). Temperature profiles showed a well-mixed water column. Average temperature by 50 m depth bin ranged from 4.5-3.1°C between the surface and 850 m (Fig. 7). Surface temperatures (Fig. 8) ranged from around 3.0 to 5.0 degrees C. Near-shore areas west of long. 167°30'W (where most pollock echo sign was detected) had warmer surface temperatures than regions farther offshore or east of long. 167°30'W.

SCIENTIFIC PERSONNEL

<u>Name</u>	<u>Sex/ Nationality</u>	<u>Position</u>	<u>Organization</u>
Taina Honkalehto	F/USA	Chief Scientist	AFSC
Daniel Twohig	M/USA	Electronics Tech.	AFSC
Neal Williamson	M/USA	Fish. Biologist	AFSC
Steve de Blois	M/USA	Fish. Biologist	AFSC
Mike Guttormsen	M/USA	Fish. Biologist	AFSC
Kevin Landgraf	M/USA	Fish. Biologist	AFSC
Yoshimi Takao	M/Japan	Fish. Acoustician	NRIFE
Seok-Gwan Choi	M/Korea	Fish. Acoustician	NFRDI

AFSC - Alaska Fisheries Science Center, Seattle, WA

NFRDI - National Fisheries Research and Development Institute,
Pusan, South Korea
NRIFE - National Research Institute for Fisheries Engineering,
Hasaki, Japan

For further information contact Dr. Gary Stauffer, Director,
Resource Assessment and Conservation Engineering Division, Alaska
Fisheries Science Center, National Marine Fisheries Service, 7600
Sand Point Way NE., Building 4, BIN C15700, Seattle, WA 98115-
0070 Telephone (206) 526-4170

Table 1. Summary of sphere calibrations conducted before, during, and after the winter 1998 pollock echo integration-trawl survey of the Bogoslof Island region.

Date (1998)	Location	Freq (kHz)	Water Temp (deg. C) at Transducer*	Sphere Range		TS Gain (dB)	SV Gain (dB)	Along		Angle Offset Along	Offset Athwart
				from Transducer (m)	to Sphere			3 dB Beam Width (deg.)	Beam		
05 Feb	Port Susan, WA	38	9.4	10.0	28.3	27.2	27.2	6.73	0.01	-0.03	
01 Mar	Nateekin Bay, A	38	3.6	3.8	26.8	27.0	--	--	--	--	
10 Mar	Captains Bay, A	38	3.8	3.7	32.1	27.1	27.1	6.79	0.01	-0.03	
24 Mar	Spidiron Bay, Al	38	5.3	5.4	34.4	27.1	27.1	--	--	--	
Feb-Mar	System settings during surveys	38	--	--	--	27.1	27.1	6.70	-0.09	-0.02	

* The transducer is located approximately 9 m below the water surface.

Note: Gain and beam pattern terms are defined in the "Operator Manual for Simrad EK500 Scientific Echo Sounder (1993)" available from Simrad Subsea A/S , Standpromenaden 50, P.O. Box 111 N-3191 Horten, Norway.

Table 2. Summary of midwater trawl stations and catch data from the winter 1998 pollock echo integration-trawl survey of the Bogoslof Island area.

Haul No.	Date (GMT)	Time (GMT)	Duration (minutes)	Start Position				Gear	Bottom	Gear	Surface	MBT No.	Pollock kg
				Latitude (N)		Longitude (W)							
1	2 Mar	11:04	26	54	23.59	166	0.20	516	549	3.5	3.8	2	438.5
2	2 Mar	18:39	25	54	12.69	166	17.85	487	523	4.0	3.7	3	966.5
3	4 Mar	1:10	8	53	37.14	167	43.43	447	922	3.7	4.7	4	1075.0
4	4 Mar	8:52	30	54	34.31	167	43.96	348	831	4.3	3.8	5	0.0
5	7 Mar	10:41	2	53	12.91	169	4.07	330	678	4.1	4.7	6	3781.8
6	7 Mar	14:41	21	53	6.48	169	6.90	479	683	4.0	4.4	7	468.5
7	7 Mar	20:26	31	53	11.49	169	11.51	512	809	3.8	4.6	8	692.0
8	7 Mar	23:53	16	53	13.32	169	7.78	489	582	3.8	4.7	9	1445.3
9	8 Mar	5:12	2	53	6.10	169	9.64	342	918	4.3	4.7	10	1132.3
10	8 Mar	10:50	45	53	3.51	169	21.02	583	896	3.7	4.8	11	1143.3
11	8 Mar	15:35	6	53	3.28	169	15.12	459	903	4.1	4.8	12	2766.0
12	8 Mar	20:07	14	53	8.86	169	8.57	480	1138	3.8	4.7	13	1368.1
13	10 Mar	5:11	6	53	37.61	167	40.33	429	1113	4.0	4.6	14	1613.4
14	10 Mar	7:14	10	53	38.54	167	46.98	431	816	4.1	4.5	15	1693.7

Catch number	Other Catch kg
584	15.0
1160	6.1
933	7.7
0	2.2
2472	8.2
324	6.6
606	14.0
1248	2.0
1195	0.8
968	114.9
2421	0.0
1276	11.8
1421	3.0
1482	16.3

Table 3. Summary of pollock biological samples and measurements collected during the winter 1998 echo integration-trawl survey of the Bogoslof Island area.

Haul	Length	Maturity	Otoliths	Fish Weight	Ovary Weight
1	322	94	94	94	40
2	309	75	75	75	36
3	275	73	73	73	31
5	269	52	52	52	47
6	324	79	79	51	44
7	296	122	122	61	10
8	310	116	116	63	10
9	317	140	140	64	5
10	382	89	89	89	17
11	301	88	88	59	14
12	288	89	89	89	58
13	310	126	71	71	51
14	310	118	103	103	86
Totals	4,013	1,261	1,191	944	449

Table 4. Summary of biological samples collected for special projects during the winter 1998 pollock echo integration-trawl survey of the Bogoslof Island area (MF9802).

Haul	Pollock Spawning (M/F)	Observ.Pro. Samples POL/RF ¹	Frozen MYC ²	Pollock Ovary Collection	Pollock #1 ³	// Genetic #2 ⁴	NMML Steller Prey Items	S.L Macrourid Collection	Korean Ovaries Collection
1	-	POL	MYC	11	100	-	SQ	-	-
2	-	POL	MYC	29	-	-	SQ	-	-
3	-	SA	MYC	5	100	-	SA, SQ	-	-
4	-	-	MYC	-	-	-	SQ	-	-
5	-	-	-	1	-	-	-	-	50
6	-	-	MYC	-	100	-	SQ	-	-
7	-	-	-	-	-	20	-	-	-
8	-	POL	-	1	-	20	POL	-	-
9	-	-	-	-	-	20	-	-	-
10	-	-	MYC	-	-	-	SQ	6	-
11	-	-	-	-	-	20	-	-	-
12	-	POL	MYC	-	-	20	SQ	-	-
13 (3/~5)(3/~5)	-	-	MYC	-	-	-	-	-	-
14	-	SA	MYC	-	-	-	SA, SQ	-	-
<hr/>									
Total	18,000 EGC	POL, SA	MYC	47	300	100	SA,SQ,POL	6	50

¹ Pollock/Rockfish/Salmon

Y - collection made

² Myctophidae

POL-Pollock, SA-Salmon, SQ-Squid

³ #1-Fin clips only

⁴ #2-Muscle, Heart and liver

Table 5. Summary of catch by species in 14 Aleutian Wing trawls during the 1998 echo integration-trawl survey of the Bogoslof Island area.

Common Name	Scientific Name	Weight (kg)	Weight (%)	Numbers
Walleye Pollock	<i>Theragra chalcogramma</i>	18,584.3	98.9	16,090
Lanternfish Unidentified	Myctophidae	111.0	0.6	10,158
Giant Grenadier	<i>Albatrossia pectoralis</i>	25.8	0.1	6
Squid Unidentified	Teuthoidea	16.0	0.1	158
Smooth Lumpsucker	<i>Aptocyclus ventricosus</i>	10.1	0.1	4
Pacific Lamprey	<i>Lampetra tridentata</i>	9.6	0.1	23
Arrowtooth Flounder	<i>Atheresthes stomias</i>	9.4	0.1	9
Jellyfish Unidentified	Scyphozoa	6.6	<0.1	0
Octopus Unidentified	Octopoda	5.0	<0.1	10
Greenland Turbot	<i>Reinhardtius hippoglossoides</i>	4.0	<0.1	1
Northern Smoothtongue	<i>Leuroglossus schmidti</i>	2.8	<0.1	588
Salmon Unidentified	Salmonidae	2.5	<0.1	15
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	1.3	<0.1	1
Sponge Unidentified	Porifera	1.2	<0.1	1
Magistrate Armhook Squid	<i>Beryteuthis magister</i>	0.9	<0.1	1
Pacific Ocean Perch	<i>Sebastes alutus</i>	0.6	<0.1	1
Pacific Viperfish	<i>Chauliodus macouni</i>	0.6	<0.1	16
Sea Fan	Gorgonacea	0.5	<0.1	7
Golden King Crab	<i>Lithodes aequispina</i>	0.4	<0.1	1
Slender Barracudina	<i>Lestidiops ringens</i>	0.2	<0.1	8
Shrimp Unidentified	Decapoda	0.2	<0.1	90
Eulachon	<i>Thaleichthys pacificus</i>	0.1	<0.1	1
Eelpout Unidentified	Zoarcidae	<0.1	<0.1	3
Viperfish Unidentified	Chauliodontidae	<0.1	<0.1	1
Totals		18,793.2		27,193

Table 6. Summary of conductivity-temperature-depth (CTD) and expendable bathy-thermograph (XBT) casts made prior to and during the winter 1998 echo integration-trawl survey of the Bogoslof Island area.

Cast type	Number	Date	Time (GMT)	Latitude (N)	Longitude (W)	Depth (m)	
						Cast	Bottom
CTD	500	5 Feb	14:30	48 10.41	122 26.01	82	106
CTD	501	2 Mar	2:41	53 53.14	166 37.9	69	75
CTD	502	2 Mar	6:10	54 6.63	166 28.94	449	500
CTD	503	7 Mar	12:31	53 13.32	169 3.91	354	641
CTD	504	7 Mar	16:47	53 6.32	169 8.90	392	835
CTD	505	8 Mar	7:43	53 6.04	169 9.92	788	918
CTD	506	10 Mar	9:25	53 38.16	167 46.15	728	792
CTD	507	10 Mar	23:50	53 51.9	166 34.8	88	92
XBT	1			*** bad cast ***			
XBT	2	9 Mar	20:35	54 3.72	169 25.03	809	>1,500

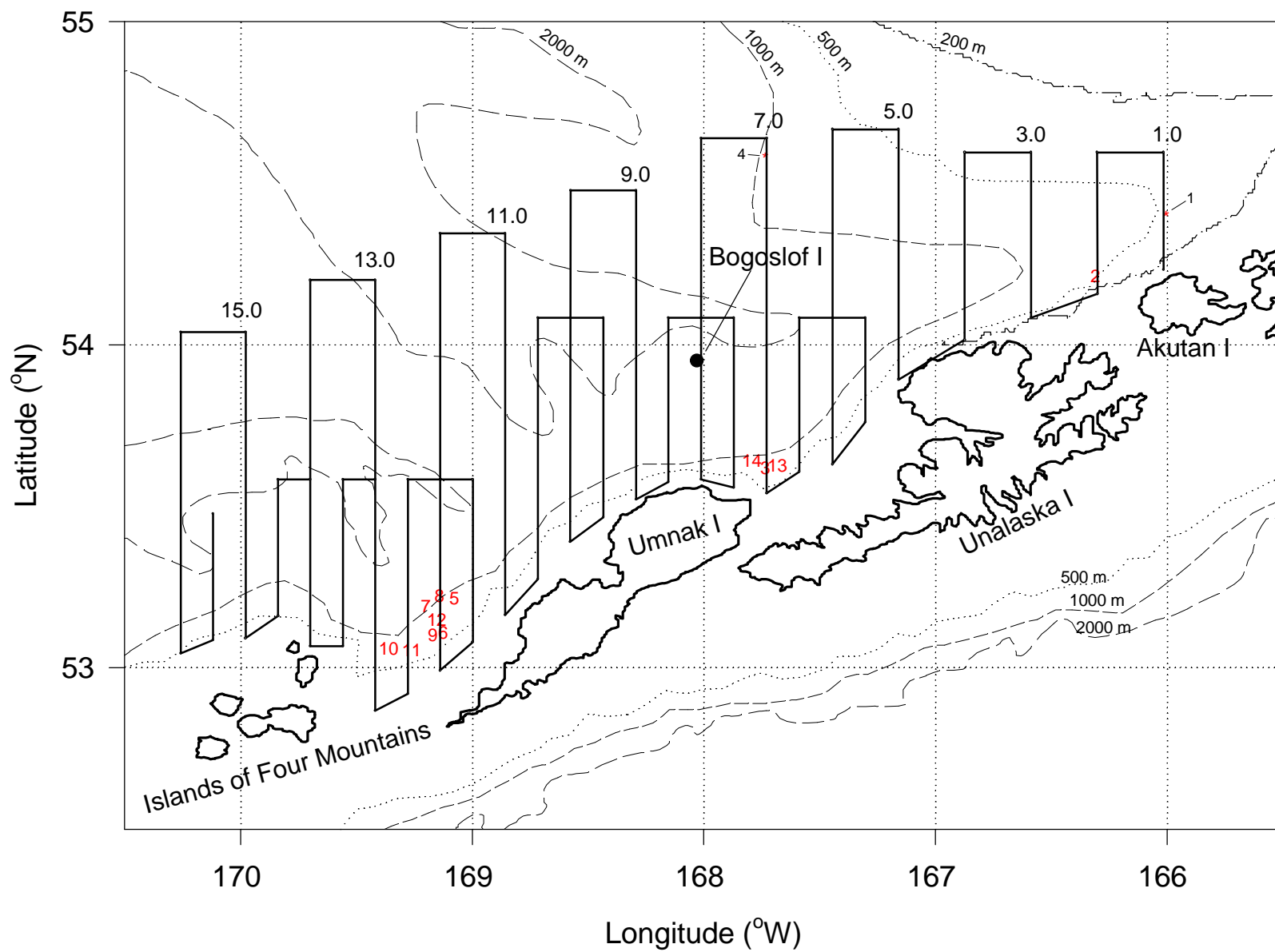


Figure 1. Trackline and haul locations from the winter 1998 echo integration-trawl survey of the Bogoslof Island area.

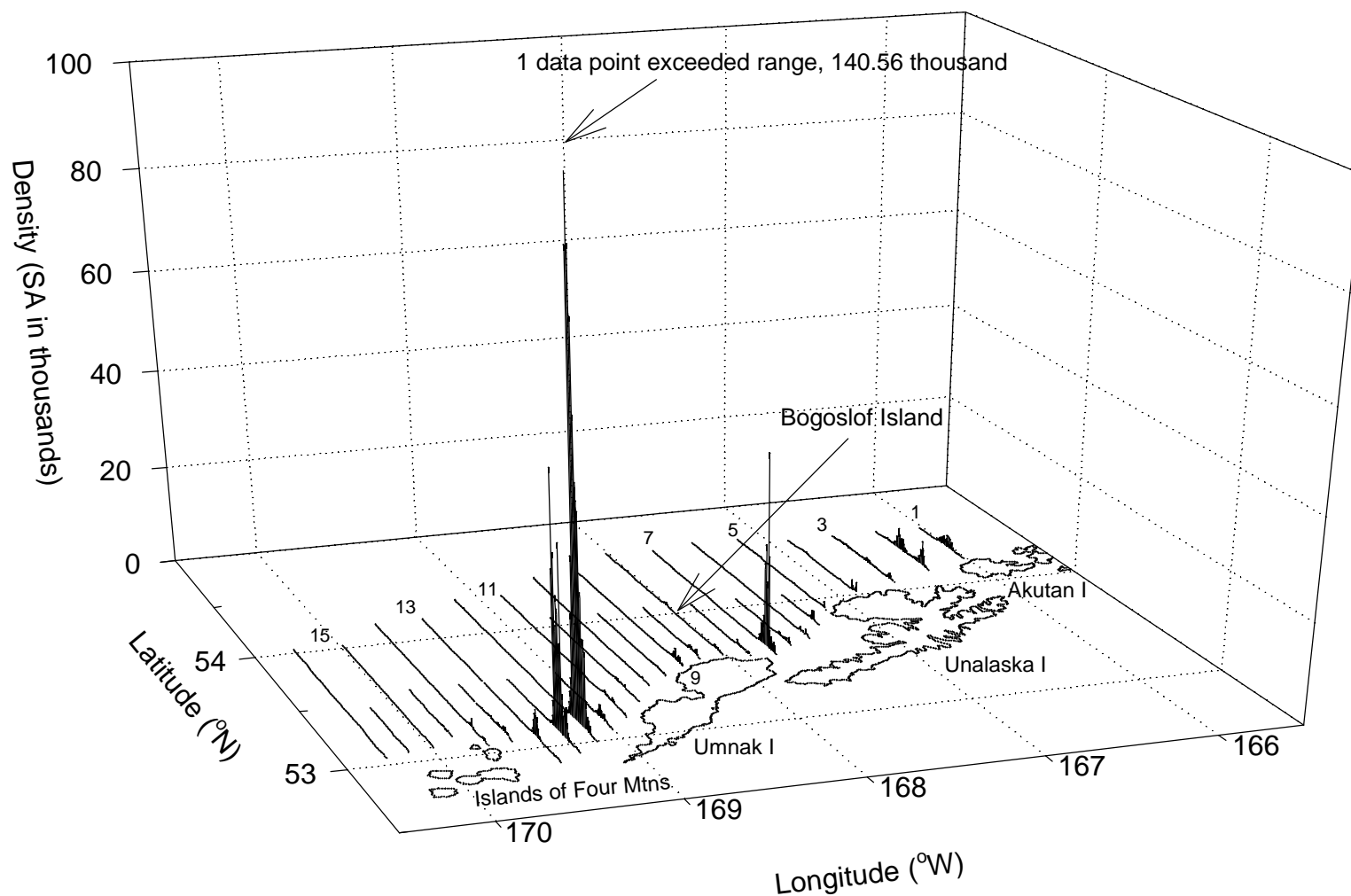


Figure 2. Relative pollock density along trackline from the winter 1998 echo integration-trawl survey of the Bogoslof Island area. Transect numbers are indicated.

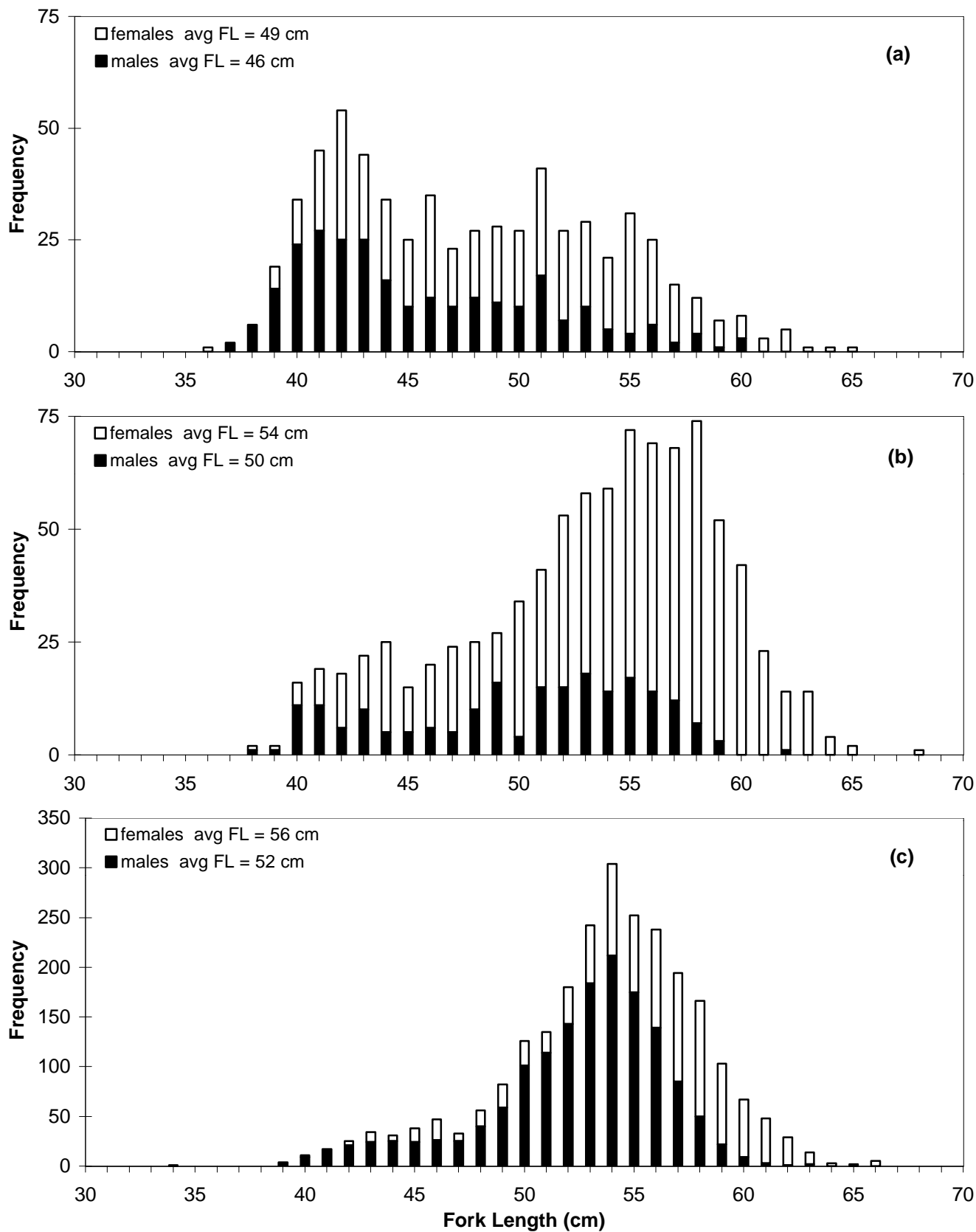


Figure 3. Pooled raw length frequencies from midwater trawls (a) east of 167 deg. W, (b) between 167 and 168 deg. W, and (c) west of 168 deg. W from the winter 1998 echo integration-trawl survey of the Bogoslof Island area.

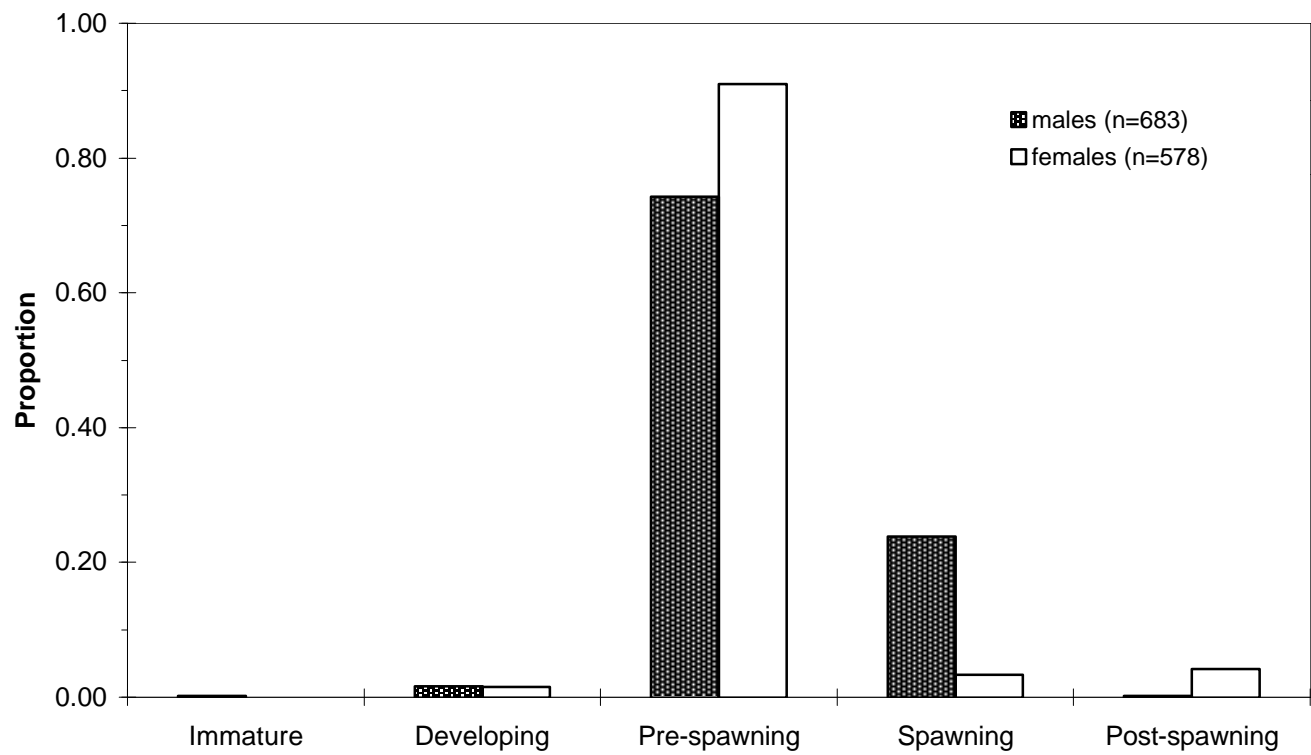


Figure 4. Maturity stages of pollock observed during the winter 1998 echo integration-trawl survey of the Bogoslof Island area.

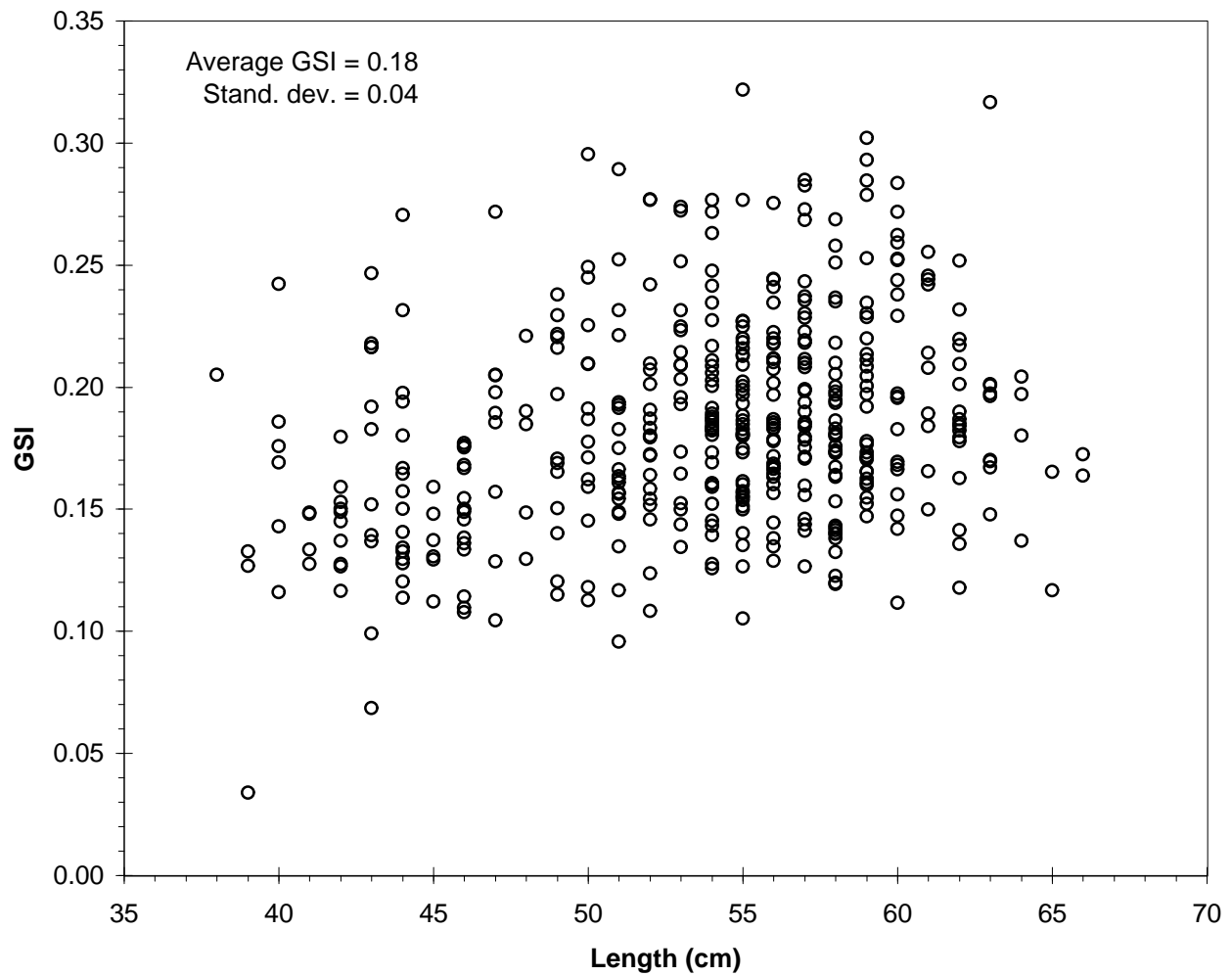


Figure 5. Pollock gonado-somatic indices for mature females plotted as a function of length from the winter 1998 echo integration-trawl survey of the Bogoslof Island area.

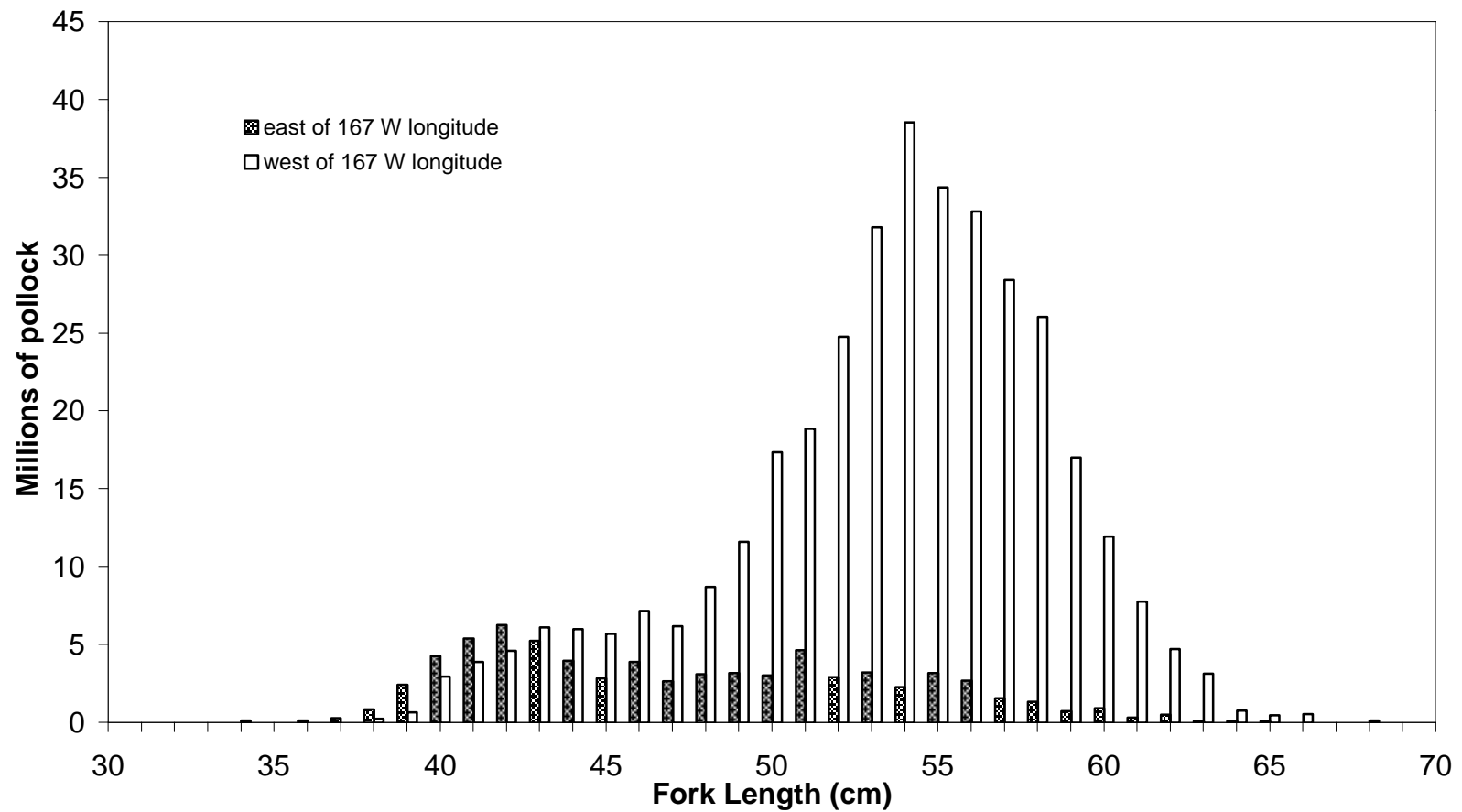


Figure 6. Estimated pollock numbers at length from the winter 1998 echo integration-trawl survey of the Bogoslof Island area.

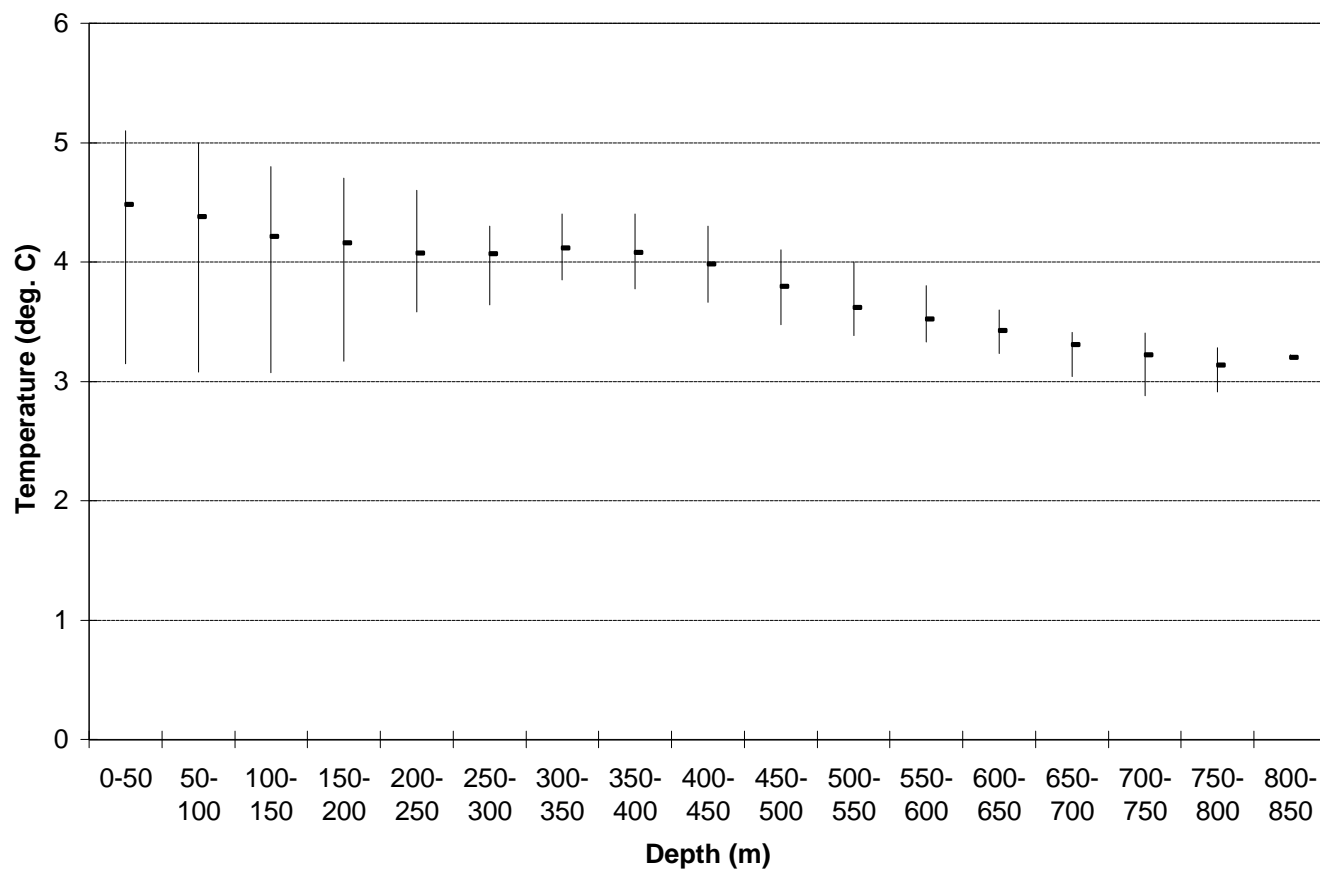


Figure 7. Average temperature (with min-max range) by 50-m depth sections observed during the winter 1998 echo integration-trawl survey of pollock in the Bogoslof Island area. Data compiled from CTD, MBT, and XBT casts.

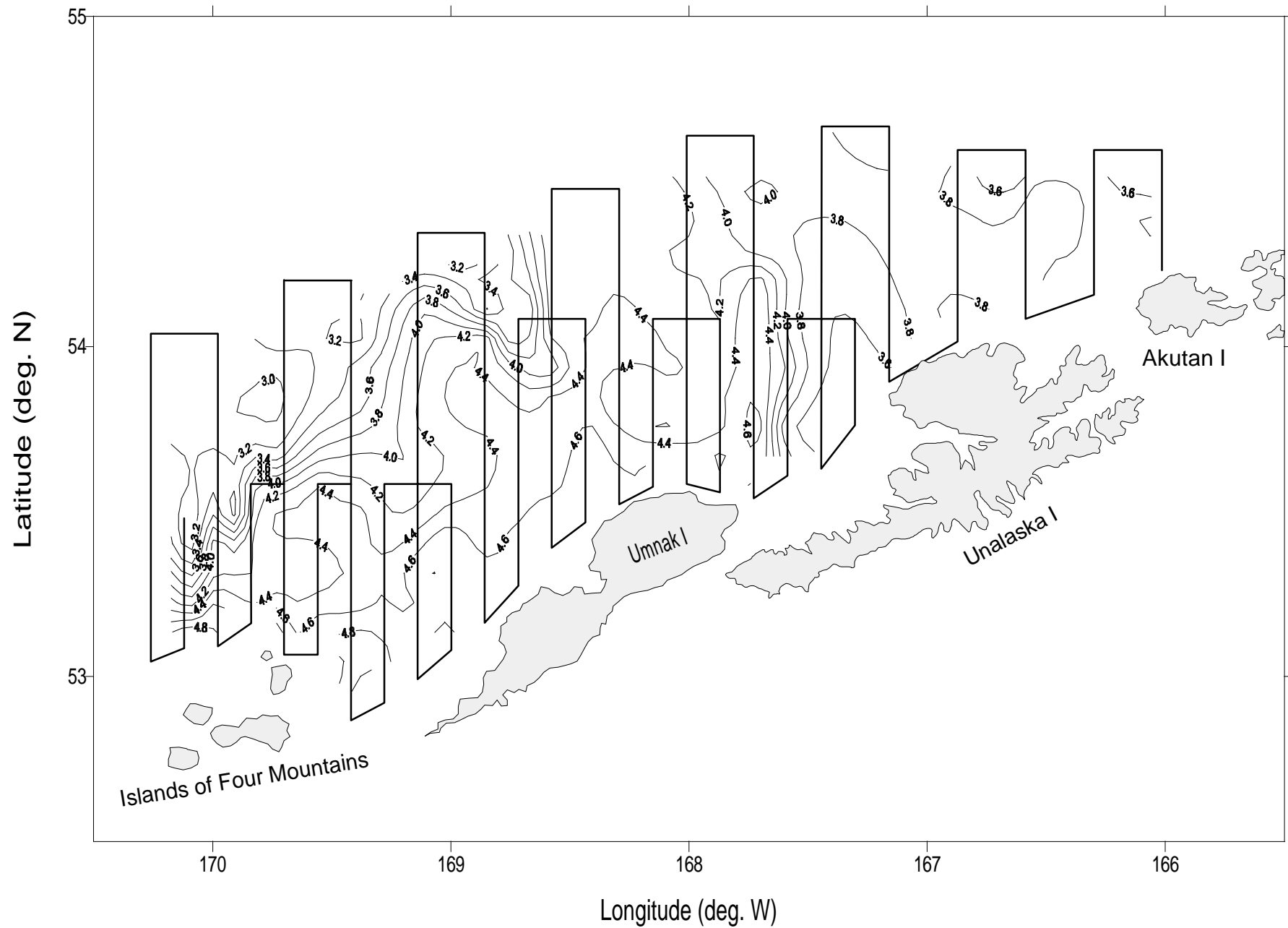


Figure 8. Transect lines with surface temperature contours (in degrees C) during the winter 1998 pollock echo integration-trawl survey of the Bogoslof Island area.